DECAY OF PHOSDRIN RESIDUE ON OUTER LEAVES OF HEAD LETTUCE IMPERIAL COUNTY

By

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Worker Health and Safety Branch
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INTRODUCTION

Phosdrin is an extremely toxic, short-lived organophosphate pesticide registered for use on a wide variety of fruit, vegetable and forage crops. On lettuce, Phosdrin is a useful control for aphid and leafhoppers. Phosdrin is often applied prior to harvest to ensure insect free lettuce for the market.

Label directions of Phosdrin 4E formulations require dosage rates of 1 to 2 pints per acre. The preharvest intervals are 2 days at the 1 pint rate and 4 days at 1 to 2 pints per acre.

In order to evaluate the level of safety afforded workers involved in lettuce harvest by the preharvest interval, lettuce crops were sampled at intervals following Phosdrin application. The study was completed during January under cool weather conditions when possibility of slow residue decay was greatest.

APPLICATION AND SAMPLING

Phosdrin decay on five lettuce fields in the vicinity of El Centro, Imperial County, were studied. The applications were made during early morning hours by aircraft at dosage rate ranging from 1.1 to 2 pints Phosdrin 4E per acre at 7-10 gallons per acre volume. Several similar brand name Phosdrin 4E formulations (4 lbs. active ingredient per gallon of concentrate) were used in the applications. The more toxic α isomer of Phosdrin constitutes approximately 60% of the active ingredient content. Immediately previous to each application, two heads of lettuce were collected for determination of background residue levels.

The outer leaves of head lettuce which workers would handle during the harvest operation were sampled at intervals beginning one hour after application. Three samples, each consisting of approximately 80 leaf discs, 2.5 cm. in diameter, were collected from 80 different heads with a leaf punch and stored in 4.5 x 10 cm. jars. The samples were placed in ice for transportation to the laboratory.

ANALYTICAL PROCEDURES.

Analysis of the lettuce samples was completed in a California Department of Food and Agriculture mobile laboratory stationed at the Imperial County Agricultural Commissioner's service yard in El Centro. The preapplication lettuce head samples were analyzed for total residue. Two of each set of three post-application leaf disc samples were analyzed for dislodgeable and penetrated residues; the third was analyzed for total residue. The procedure used for the extraction of dislodgeable, penetrated and total residues from leaf discs is detailed in an attachment.

The samples were analyzed with a Varian series 2700 gas chromatograph equipped with a flame photometric detector in its sulfer specific mode and under the following conditions:

PERSONNEL

California Department of Food and Agriculture, Division of Inspection Services and Chemistry Laboratory Services:

Keith Maddy	- Staff Toxicologist
James Knaak	- Staff Toxicologist
Jerry Alexander	- Agricultural Chemist
A. Scott Fredrickson	- Agricultural Chemist
Terry Jackson	- Agricultural Chemist
Peter Schlocker	- Agricultural Chemist
Kim Hentschel	- Agricultural Inspector
Charles Kahn	- Agricultural Inspector
Lori Peterson	- Agricultural Inspector

Imperial County Agricultural Commissioner's office:

Claude M. Finnell	- County Agricultural Commissioner
John V. Taylor	- Deputy County Agricultural Commissioner
Charles R. Wagner	- Deputy County Agricultural Commissioner
William E. McPhail	- County Agricultural Biologist III
Miguel A. Monroy	- County Agricultural Biologist II

Column	- 6 ft. x 2 mm I.D., 3% OV - 275 on 100/120 mesh Chrom W (HP) at 175° C
Injector Temperature	- 230° C
Detector Temperature	- 230° C
Retention Times:	
∝ Phosdrin	- 2.0 min.
β Phosdrin	- 2.8 min.

Quantitation was based on peak heights of duplicate injections of standard and sample. The detector was approximately five times more sensitive to the ∝ isomer as to the B isomer.

RESULTS

Daily weather observations made at El Centro over the study period are given in Table 1. The average maximum and minimum daily temperatures were 72.4 and 35.8°F. No precipitation occurred during the study period; however, free moisture was available as the temperature dropped below the dew point on most dates.

Application data and dislodgeable, penetrated, and total residue values are given in Table 2. Dislodgeable residues of the highly toxic ∝ isomer were near 1. ppm after 48 hours at the 1 pint per acre application rate and below 1. ppm after 72 hours at the 2 pint per acre rate. From these data it would appear that the preharvest intervals required are sufficient to protect lettuce harvest workers from insult by Phosdrin residues.

TABLE 1

DAILY TEMPERATURE AND PRECIPITATION

Observations made for the El Centro Water Department, El Centro, Imperial County, California.

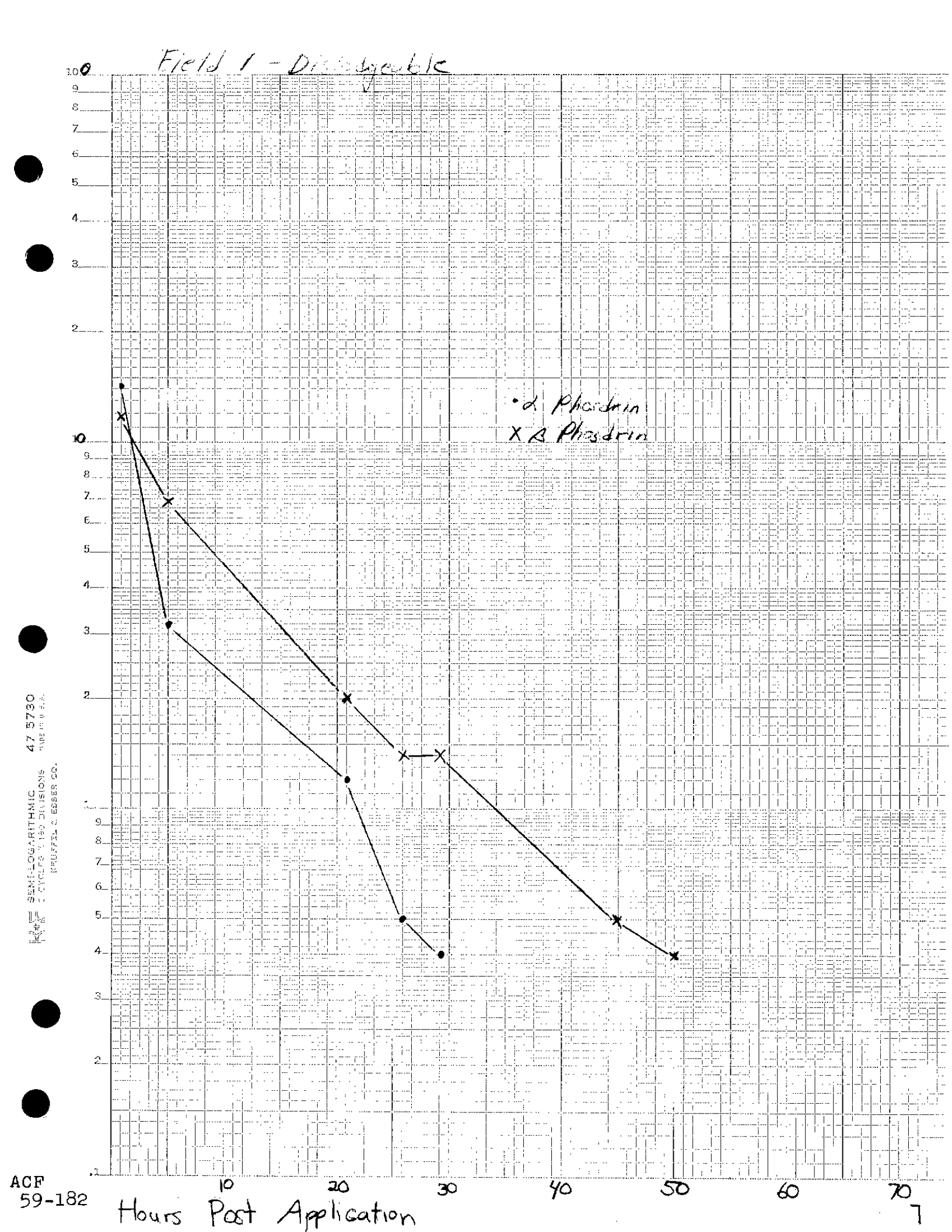
	TEMPERATURE (°F) 24 Hours Ending at 5:00 p.m.		PRECIPITATION (INCHES)	
DATE	Maximum	Minimum	24-Hour Amount	Observation Time 5:00 p.m.
1/ 7	69	41		
1/ 8	69	26		
1/ 9	69	47		
1/10	66	32		
1/11	66	38		
1/12	66	30		
1/13	70	32		
1/14	74	31		
1/15	78	31		
1/16	78	43		
1/17	80	32		
1/18	82	38		
1/19	82	39		
1/20	77	35		
1/21	78	37		
1/22	78	35		
1/23	70	34		
1/24	75	34		
1/25	78	37		
1/26	80	37		
1/27	77	46		
1/28	64	40		
1/29	64	29		
1/30	64	29		
1/31	64	32		
2/ 1	64	45		
	$\bar{X}$ 72.4	$\bar{X}$ 35.8	Total	0.0

TABLE 2

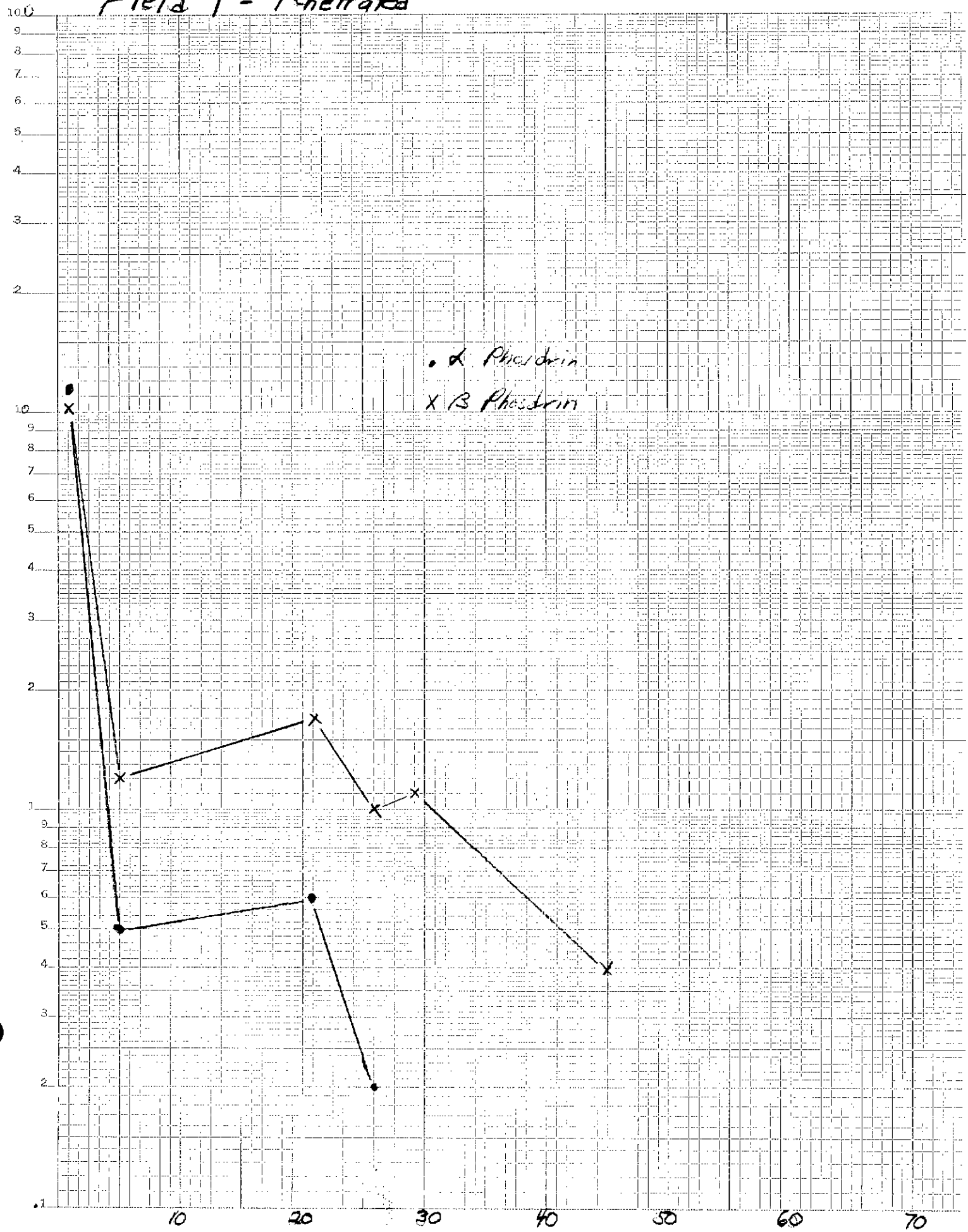
RESIDUE ON HEAD LETTUCE WRAPPER LEAVES
FOLLOWING PHOSDRIN APPLICATION TO FIVE FIELDS (PPM)

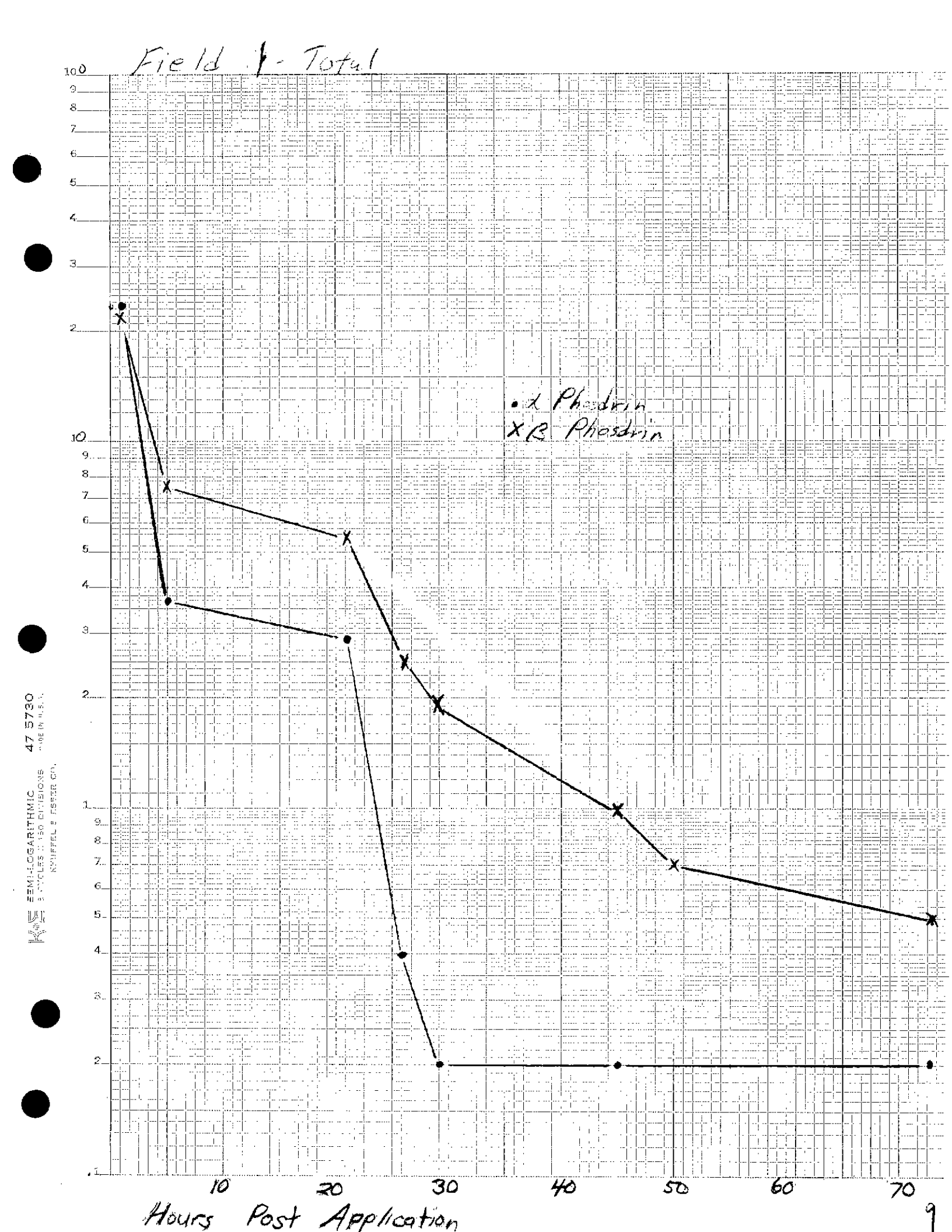
HOURS POST APPLICATION	DISLODGEABLE RESIDUE+ ∝ Phosdrin	DISLODGEABLE RESIDUE+ β Phosdrin	PENETRATED RESIDUE+ ∝ Phosdrin	PENETRATED RESIDUE+ β Phosdrin	TOTAL RESIDUE ∝ Phosdrin	TOTAL RESIDUE β Phosdrin
FIELD 1 - 1.6 pints Phosdrin 4E/10 gallons/acre applied January 7, 1975.						
Pre-application*	--	--	--	--	<0.14	<0.31
1	14.1	11.9	11.3	10.2	23.4	21.8
5	3.2	6.9	0.5	1.2	3.7	7.5
21	1.2	2.0	0.6	1.7	2.9	5.3
26	0.5	1.4	0.2	1.0	0.4	2.5
29	0.4	1.4	<0.2	1.1	0.2	1.9
45	<0.2	0.5	<0.2	0.4	0.2	1.0
50	<0.2	0.4	<0.2	<0.4	<0.2	0.7
73	<0.2	<0.4	<0.2	<0.4	0.2	0.5
FIELD 2 - 1.1 pints Phosdrin 4E/7 gallons/acre applied January 13, 1975.						
Pre-application*	--	--	--	--	<0.06	<0.1
1	10.2	6.0	3.0	1.4	13.8	7.3
24	3.7	2.9	1.2	1.8	4.0	3.8
48	1.1	1.5	.8	1.6	2.0	3.2
72	0.8	1.5	.6	1.9	1.1	2.0
FIELD 3 - 1.8 pints Phosdrin 4E/8 gallons/acre applied January 14, 1975.						
Pre-application*	--	--	--	--	<0.1	<0.3
1	10.2	9.3	6.2	4.7	19.4	17.1
5	6.8	8.1	2.1	3.0	10.7	11.6
22	3.3	4.9	1.7	3.3	4.4	6.6
28	1.7	2.8	0.7	1.5	1.7	3.1
48	0.9	2.5	0.6	3.7	1.4	5.8
FIELD 4 - 1.9 pints Phosdrin 4E/10 gallons/acre applied January 21, 1975.						
Pre-application*	--	--	--	--	<0.2	<0.1
1	11.7	9.7	11.7	5.7	23.3	15.4
24	2.3	4.8	4.2	7.6	6.5	12.3
48	1.5	2.6	0.8	2.0	2.3	4.1
FIELD 5 - 2 pints Phosdrin 4E/10 gallons/acre applied January 29, 1975.						
Pre-application*	--	--	--	--	ND**	ND
1	21.4	12.4	11.4	6.3	50.2	27.6
4	16.1	9.2	8.5	5.6	34.0	21.9
6	16.1	12.1	8.7	6.5	29.8	24.6
25	3.8	3.8	4.5	5.7	8.2	18.7
47	2.1	1.6	1.6	3.5	2.7	5.8
72	<1.0	<1.0	0.2	1.0	0.5	1.5

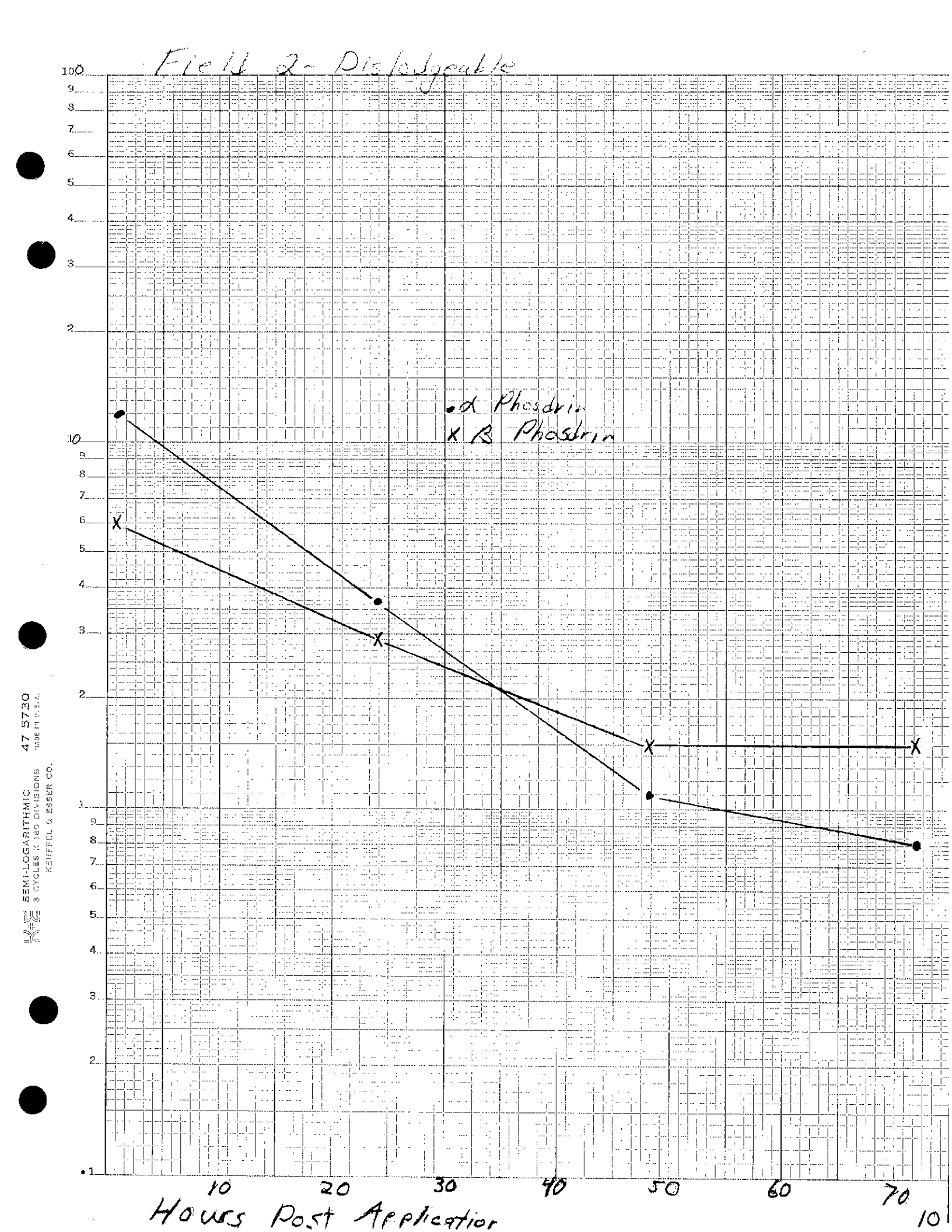
\+ Average values of duplicate samples
* Combined cross-sectional samples of two entire heads.
** Not detectable

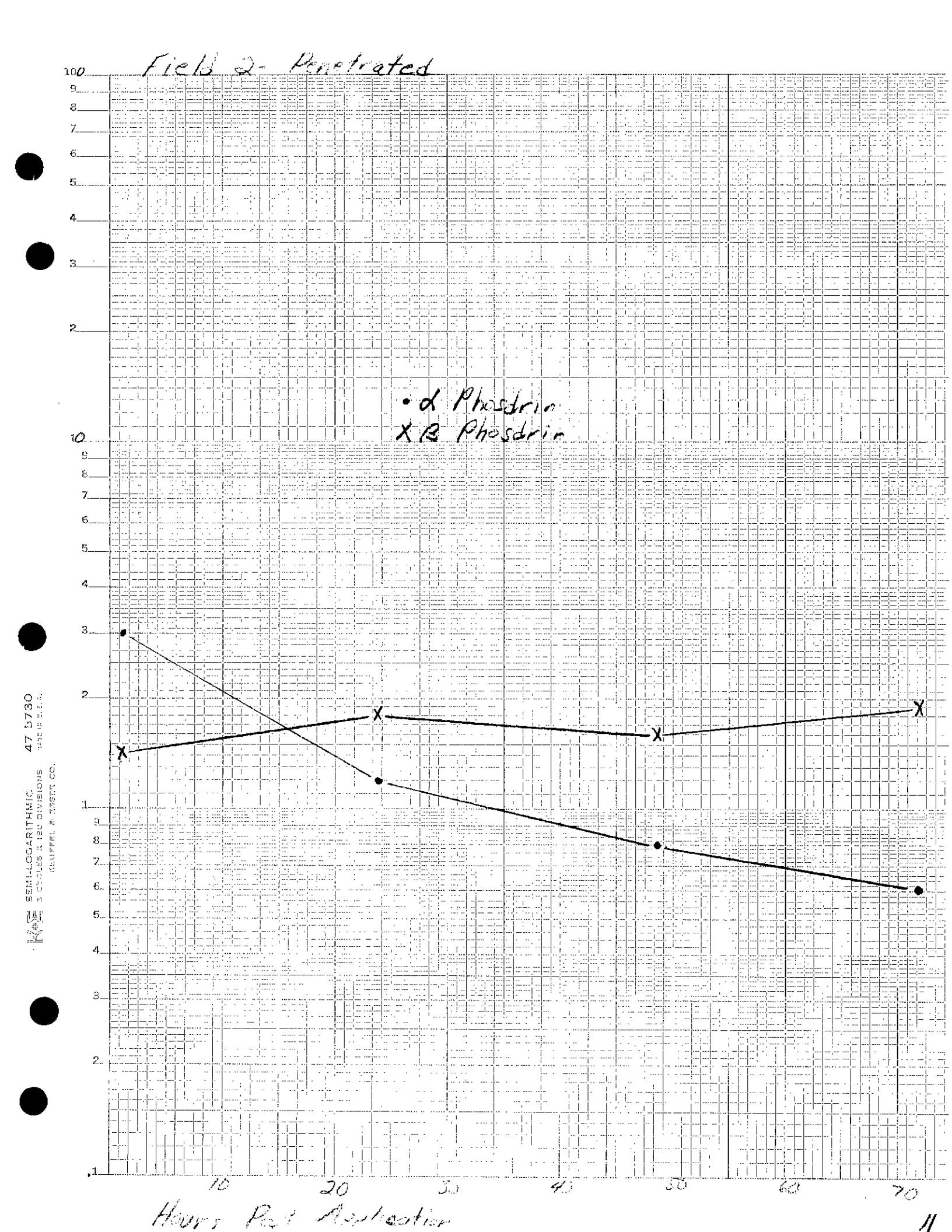

Field 1 - Dr
• α Phosdrin
X β Phosdrin
SEMI-LOGARITHMIC
47 5730
KEUFFEL & ESSER CO.
ACF
59-182
Hours Post Application

Field 1 - Penetrated

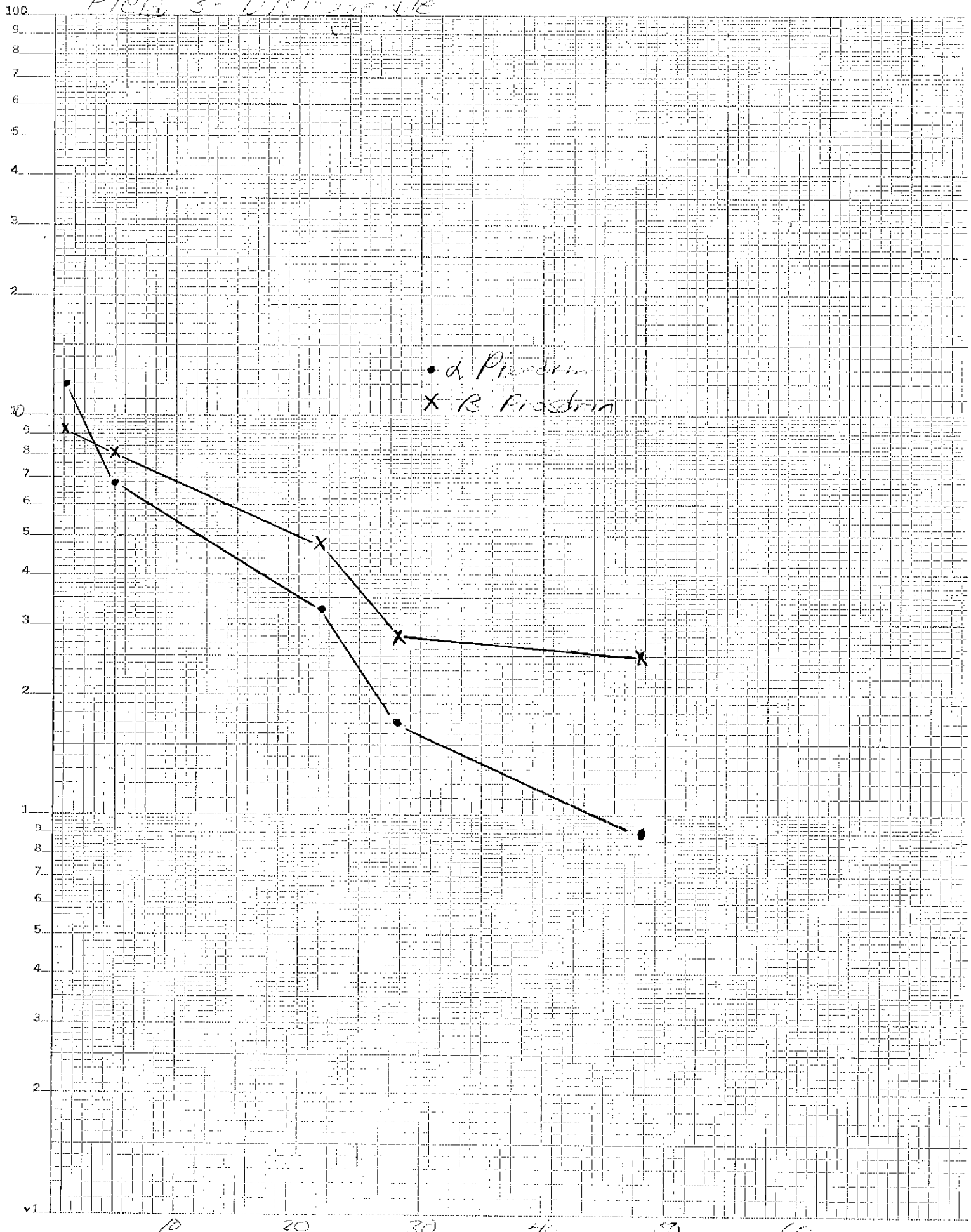


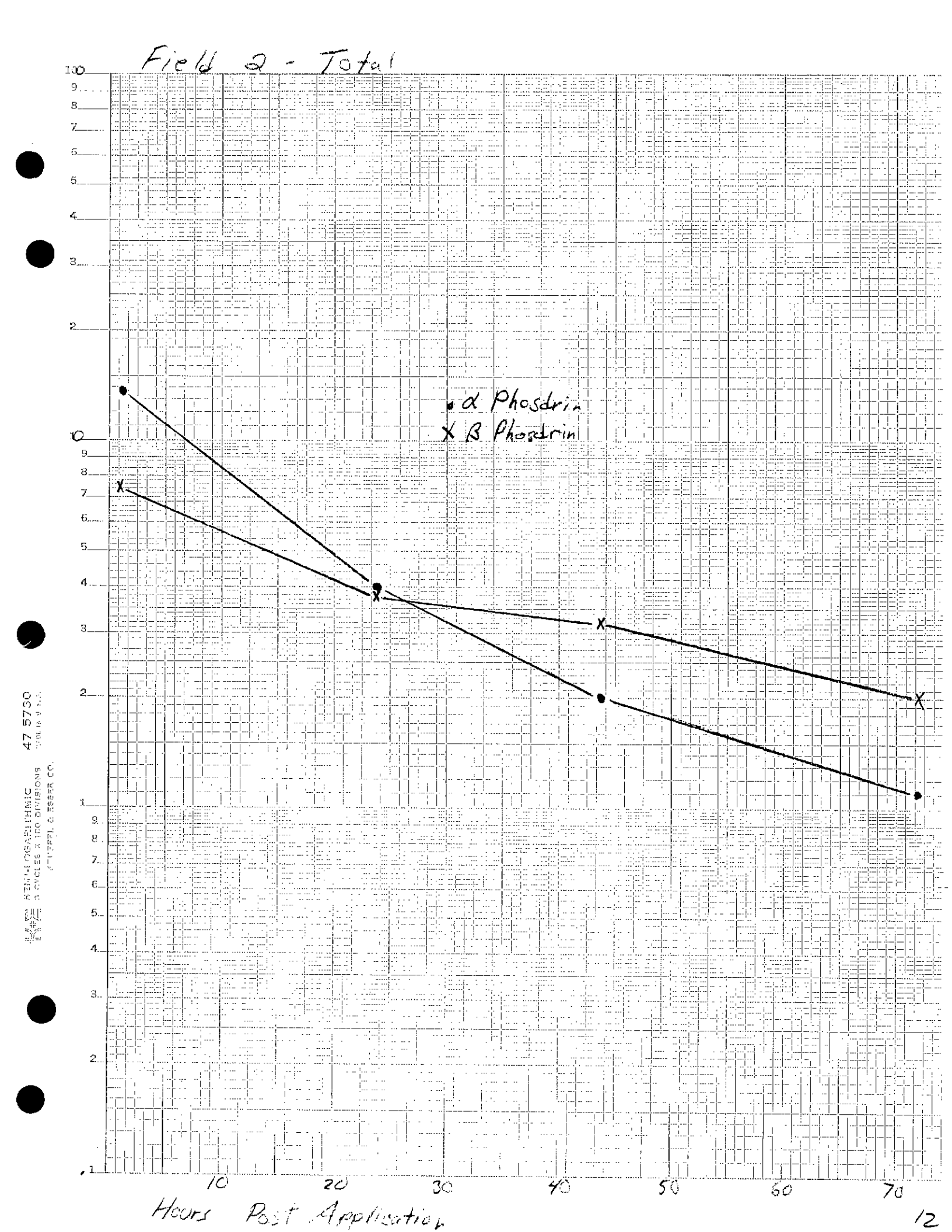

Field 4 - Total
• 1 Phosdrin
X 2 Phosdrin
100
9
8
7
6
5
4
3
2
10
9
8
7
6
5
4
3
2
1
9
8
7
6
5
4
3
2
.1
10
20
30
40
50
60
70
Hours Post Application
SEMI-LOGARITHMIC
47 5730

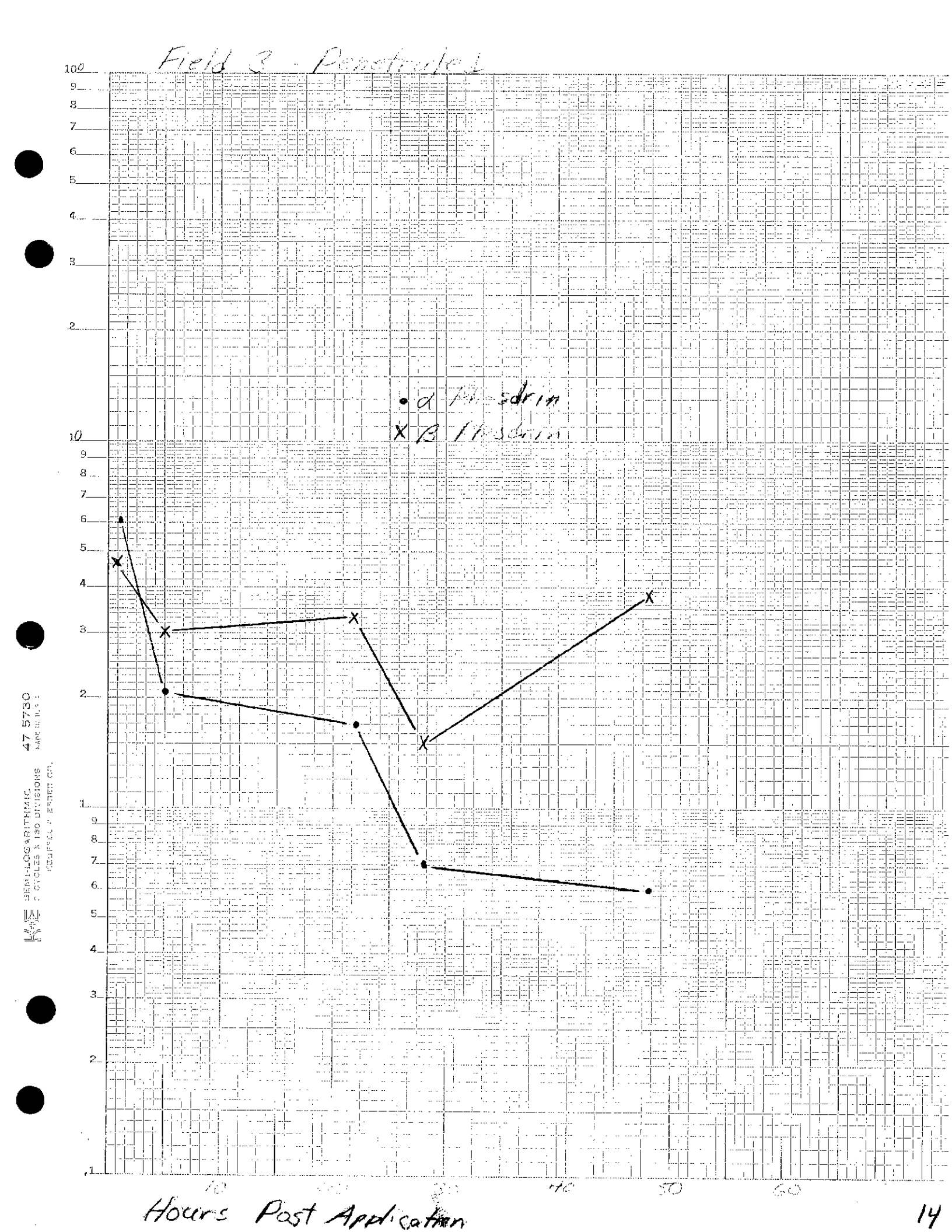

Field 2- Dichlobenil
• A Phosdrin
X B Phosdrin
100
9
8
7
6
5
4
3
2
10
9
8
7
6
5
4
3
2
1
9
8
7
6
5
4
3
2
•1
10
20
30
40
50
60
70
Hours Post Application
SEMI-LOGARITHMIC
3 CYCLES X 180 DIVISIONS
KEUFFEL & ESSER CO.
47 5730

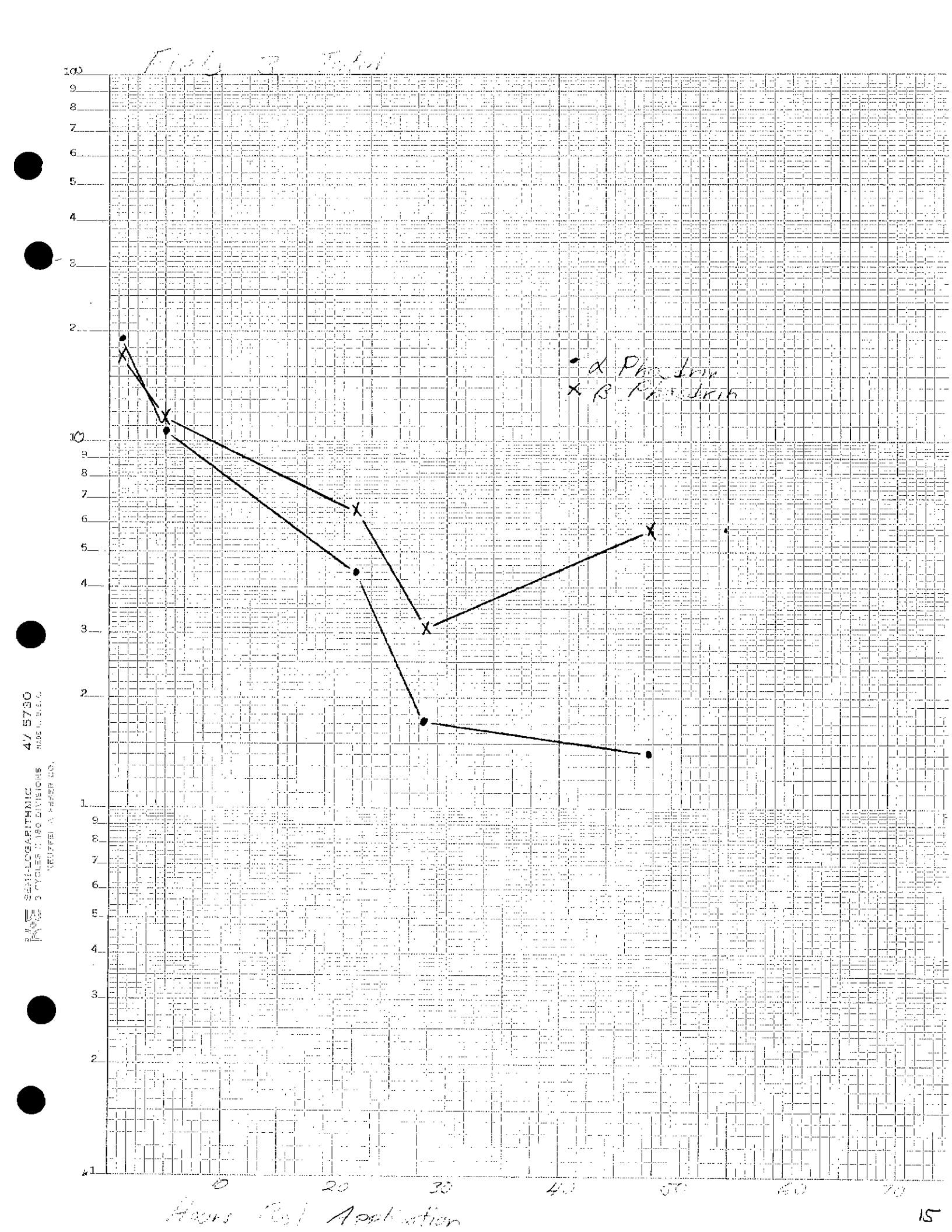

Field 2- Penetrated
• α Phosdrin
X β Phosdrin
100
9
8
7
6
5
4
3
2
10
9
8
7
6
5
4
3
2
1
9
8
7
6
5
4
3
2
.1
10
20
30
40
50
60
70
Hours Post Application
SEMI-LOGARITHMIC
3 CYCLES X 180 DIVISIONS
KEUFFEL & ESSER CO.
47 5730

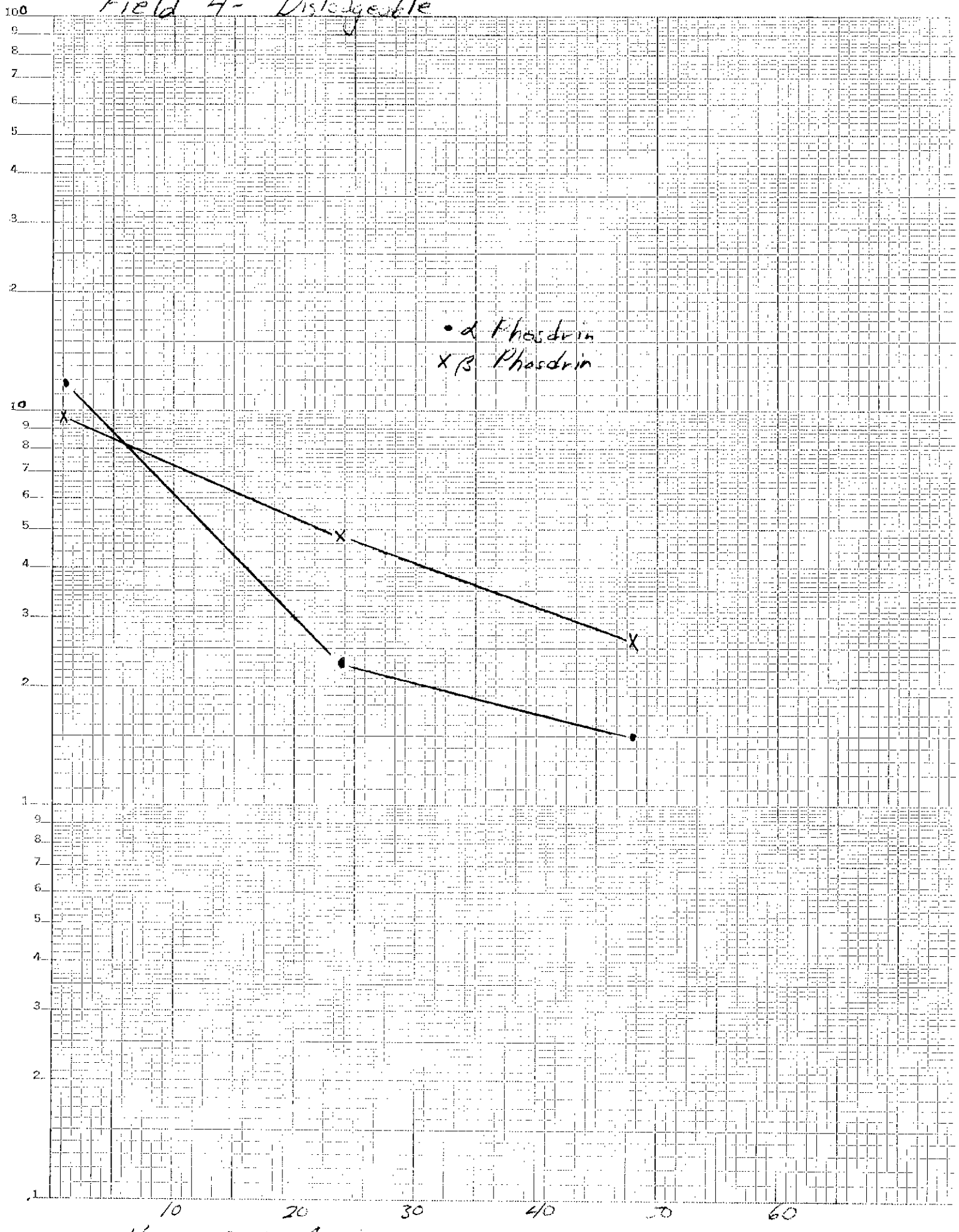
Field 3 - Dichloride



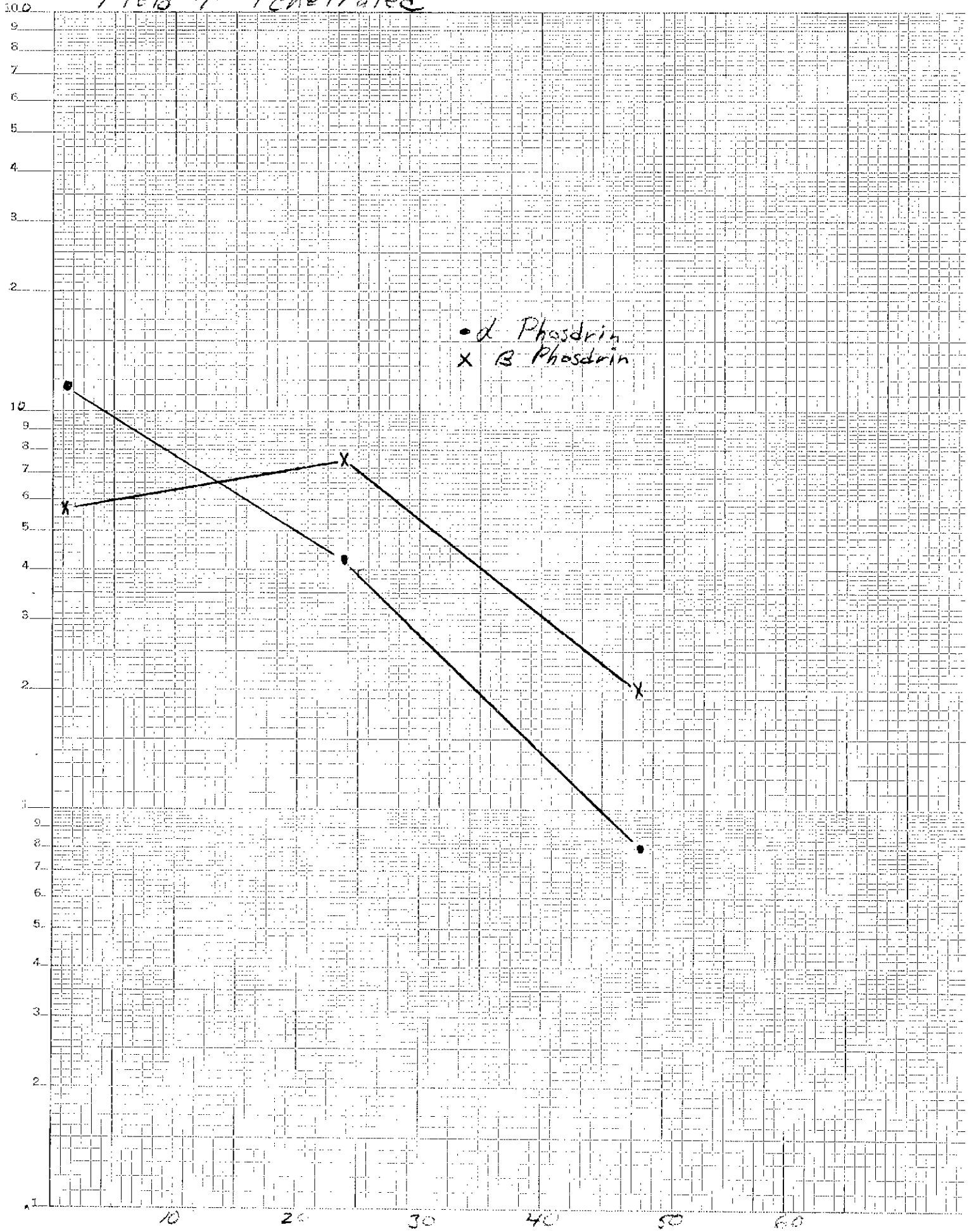

Field 2 - Total
• α Phosdrin
X β Phosdrin
100
9
8
7
6
5
4
3
2
10
9
8
7
6
5
4
3
2
1
9
8
7
6
5
4
3
2
.1
10
20
30
40
50
60
70
Hours Post Application
47 5730
12


Field 2 - Penstemon
• α Endrin
X β Endrin
100
9
8
7
6
5
4
3
2
10
9
8
7
6
5
4
3
2
1
9
8
7
6
5
4
3
2
.1
40
50
60
Hours Post Application
47 5730
SEMI-LOGARITHMIC
2 CYCLES X 180 DIVISIONS

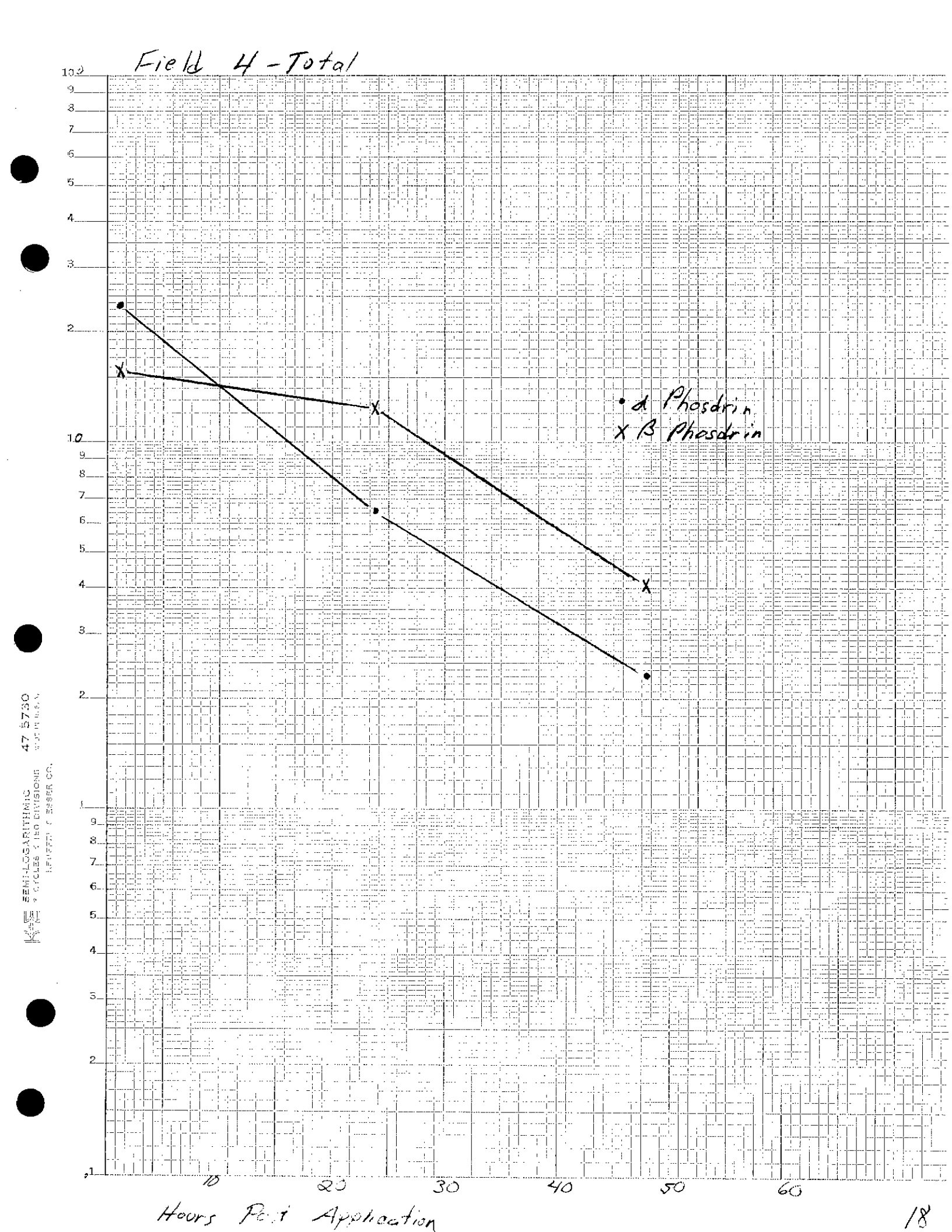

Fatty Acid Salt
• α Position
× β Position
100
9
8
7
6
5
4
3
2
10
9
8
7
6
5
4
3
2
1
9
8
7
6
5
4
3
2
1
0
20
30
40
50
60
70
Years of Application
SEMI-LOGARITHMIC
3 CYCLES X 180 DIVISIONS
4V 5730

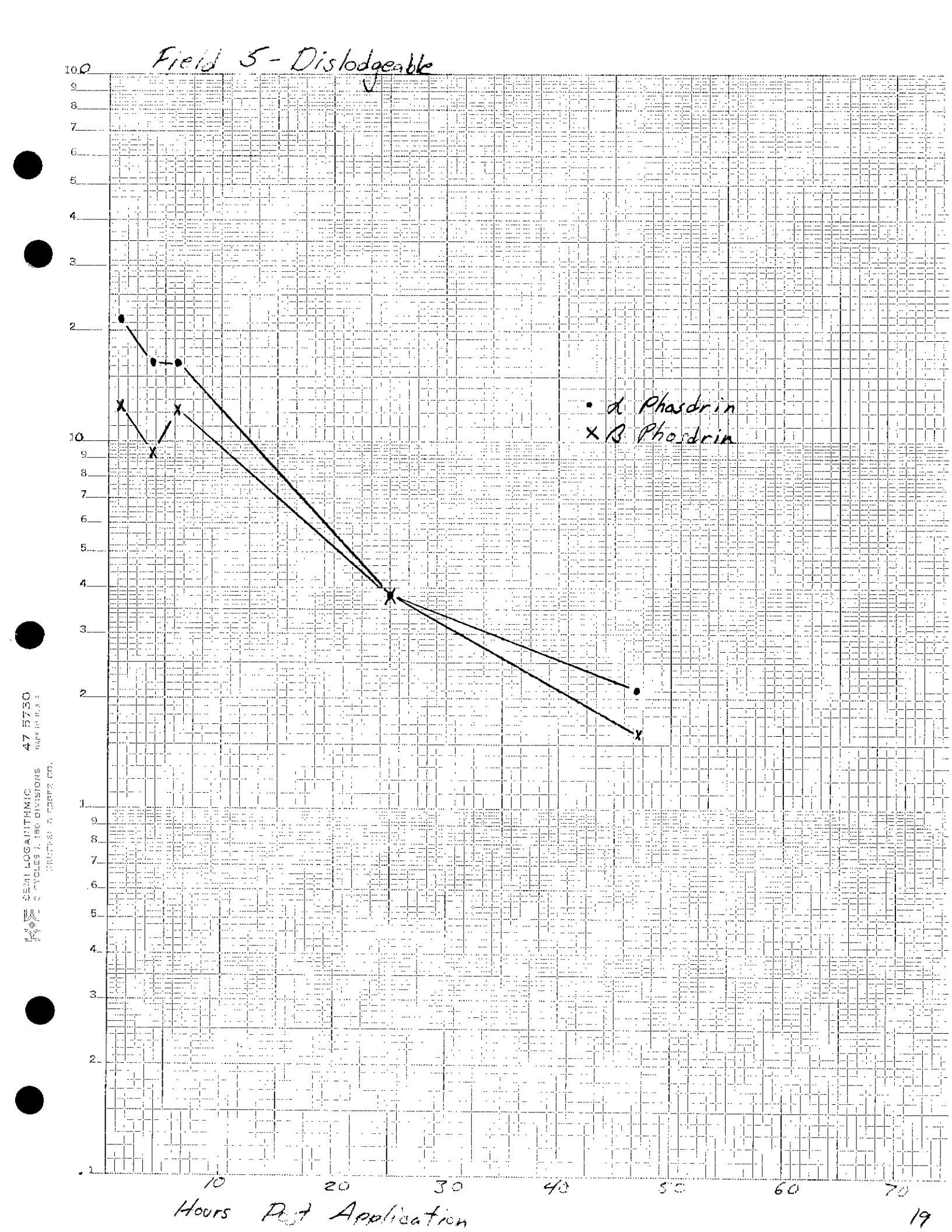


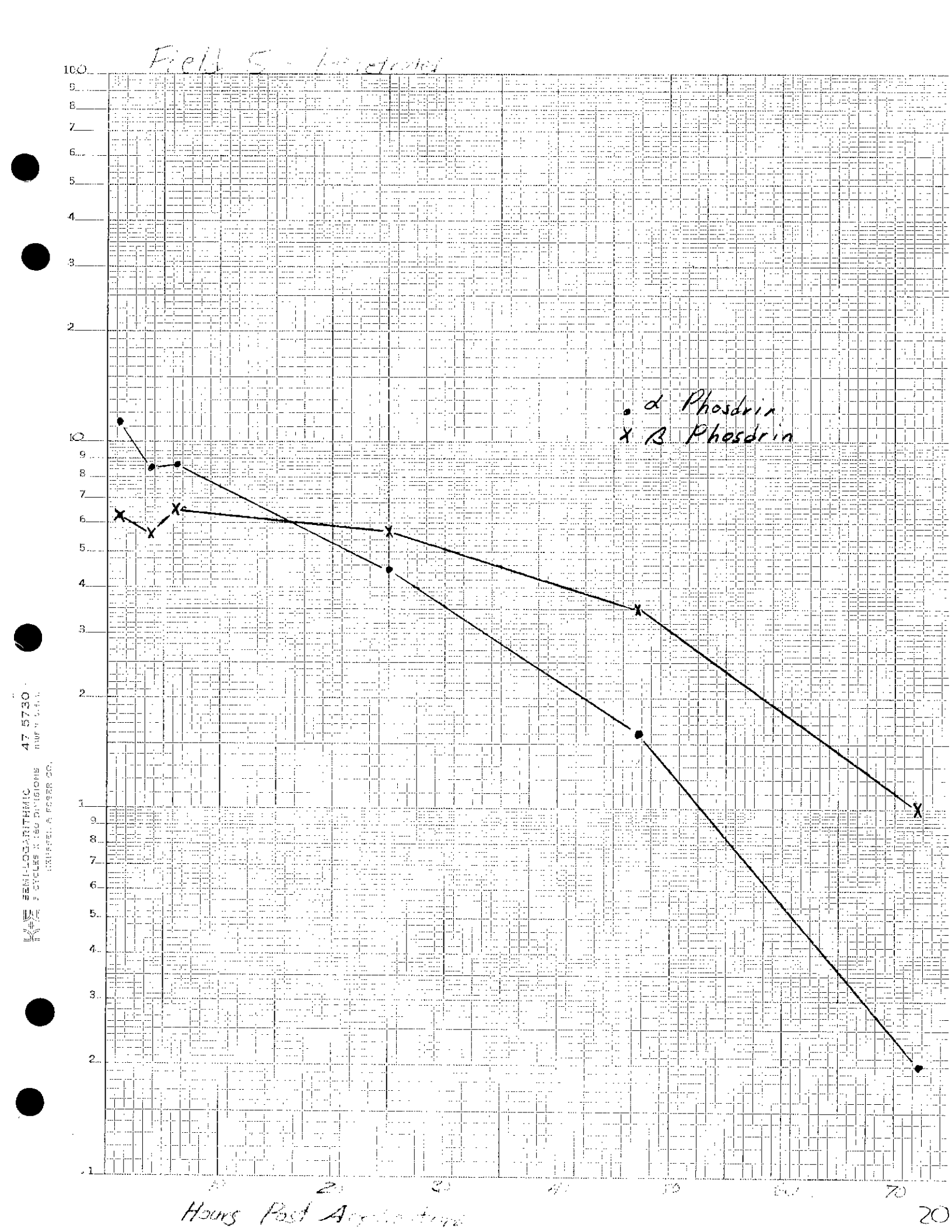
Field 4 - Penetrated



Hours Post Application


Field 4 - Total
• α Phosdrin
X β Phosdrin
Hours Post Application
10
20
30
40
50
60
SEMI-LOGARITHMIC
6 CYCLES X 140 DIVISIONS
KEUFFEL & ESSER CO.
47 5730


Field 5 - Dislodgeable
• α Phosdrin
× β Phosdrin
10
20
30
40
50
60
70
Hours Post Application
SEMI LOGARITHMIC
2 CYCLES X 10C DIVISIONS
47 5730


Fell 5 - Isoproterenol
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
α Phosdrin
β Phosdrin
10
20
30
40
50
60
70
Hours Post Application
SEMI-LOGARITHMIC
2 CYCLES X 180 DIVISIONS
KEUFFEL & ESSER CO.
47 5730